

RAILWAY ENGINEERING

and Maintenance of Way

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Broken or Failed Rails

THE blank form for the report of broken or failed rails, which was submitted at the recent meeting of the American Railway Association, will assist materially in securing a systematic record of rail failures. With this form to be filled in, all necessary information will be had for a determination of the defect of the rail. This work will not take up very much of the roadmaster's time, because it is only a matter of filling in the form from observation of broken rails.

The value of these reports will result from the accumulation of data upon which recommendations may be based with assurance that the difficulties will be overcome. Of course, it is known where the defects occur, but it is not definitely known what the extent of these failures is. The reports from all roads will give conclusive evidence.

The results, which will be secured by this practice, will no doubt be satisfactory. The manufacturers and the railroad men will then be able to find remedies for the defects and better rails will be put on the market.

Expediting Traffic

EVERY effort has been and is now being made to expedite traffic and, unless certain construction is found necessary to safeguard traffic, it is not allowed to interfere with the progress that has already been made in the way of increasing the capacity of the lines. Outside of the natural inclination of a railroad company to do all in its power to protect the lives of its patrons, it is a matter of thousands of dollars, as each wreck means many damage suits. Therefore, it is the policy of a railroad company to consider all means tending to do away with accidents.

The company's engineers must, however, keep in mind the important problem of expediting traffic. This statement refers particularly to the signal engineer who has in charge the development of a perfect system of signaling. Where an additional indication is necessary on account of existing conditions at some point on the road, it is well to make an investigation with the object in mind of changing the conditions in order to avoid another indication if such indication may curtail the capacity of the line.

In recent years the speed of trains has been materially increased. Heavier and more powerful locomotives are used and for this reason heavier rails were laid and a better and more costly roadbed was built. The expenditure of money for the reconstruction work has been enormous, but then the capacity of the road was increased, which brought greater revenue. Now, it is well to assume that the company will not, without reluctance, undo what has already been accomplished to facilitate transportation.

In the case of signaling methods, there are several solutions to the problem of safeguarding traffic. It becomes the business of the signal engineer to arrive at

the one which will meet satisfactorily the needs of the road and not hamper the operation. The maintenance of capacity of line does not influence, but only eliminates certain solutions. It is an example of a problem with two or more solutions.

The task of the signal engineer is not, however, far different from that of any other engineer. The successful solution of every new problem is limited by outside conditions. If there was but one solution, qualifications for signal engineers would not be very high.

While the method of signaling proves a good example, it is only used to illustrate the dependence of standards upon the expedition of traffic. It is necessary to keep this point in mind in the design and layout of new work.

Track Construction

THE methods of construction, which are used by track men, vary considerably on the different roads and even on different sections of the same road. The work of each section is, of course, in charge of one man, who has his own ideas of the best and most economical method of construction. Each man, as he becomes more experienced, improves on his methods and ultimately arrives at a very good method. On account of the many new men required each year, there are always some who are lacking in the experience necessary to secure the more economical methods of construction. This difficulty may be overcome in one or more ways, which really have as their basis the instruction of the road men.

In the first place it must be acknowledged that the roadmaster is familiar with the details of track construction work on account of the experience obtained from actual contact with the work. Of all the men in the track department he should know best how the work is to be done. Therefore, to enlighten him further he must be brought into contact with those men who are engaged in the same line of work. The new roadmaster will then have the opportunity of learning what the older men have found after years of experience to be the best methods.

Whether it be at a meeting of the roadmasters on his line or at a convention of roadmasters from all roads in the country, each man will get at least some information which will make him more efficient. If each roadmaster were to prepare a report of the methods he has followed on each particular job, this report would be of assistance to other men on his road. He may also note where changes might be made when he has the cost of the job figured out and the various items of expense tabulated in good form.

The valuable points, which are brought out in discussion, are often forgotten and then, too, they are not always supplemented by figures on cost which strengthen the discussion and allow methods to be compared on the proper basis. The first cost of the work and the cost of maintenance are the items upon which the final reckoning is made.

The Track Labor Question

EFFICIENT track laborers are hard to retain, as well as to secure. It is not an easy matter to pick up a gang of laborers who are experienced in track work and it is difficult to keep them when on completion of a job they must be laid off. Thus many men are broken in and drift into other work during the interim between track construction jobs. The roadmaster knows only too well the value of an efficient track gang. The importance of satisfactory labor is not doubted, yet how it may be secured and retained has not been solved.

An increase in wages has been tried with some success, but, when the work is not continuous, it does not prevent the men from scattering. Men who may become more efficient laborers can be secured by higher wages, but they are even harder to retain than the lower-waged man. The difficulty is not so much with the class of laborers, but with the experience of the men. Thus, the problem narrows down to the means of retaining these laborers in road construction work.

One solution is the organizing of track laborers in such manner that they may be more steadily employed and therefore more easily retained. While it presents difficulties on account of the unintelligent men, it is not an impossibility. It is not intended to outline a method of organization, because this matter may best be treated by the men who are engaged in the employment of laborers.

While it is hardly necessary to emphasize the importance of solving the problem, it has been deemed well to bring up the question, which is constantly troubling the roadmaster, and to urge that even greater attention be given to a means of alleviating the difficulty.

Recent Railway Conventions

THE earnestness of the members of the railway engineering and maintenance of way associations was impressed upon all at the recent conventions. The members discussed the various subjects very carefully, criticising the reports in detail. The interest which these men have in their work was shown by their desire to have the reports correct in every detail and this interest also goes to prove that the members value the information gained at these meetings.

Another feature, which is worthy of note, was the large attendance of railway supply men who have organized associations to bring before the assembled members the new devices which are on the market. The growth and strength of these railway associations is appreciated by the supply men, who realize that it is important to have the railroad men know what is being manufactured on account of the dependence of standardization upon the devices in use.

The strength of the associations is also marked by their increased membership. There is not one, but which has added materially to its membership list. The railroad companies in some cases encourage their men to join

these associations in order that they may become more efficient in their work. There is every reason to believe that these organizations will continue to grow in strength because they deal with certain subjects with which their members are the more familiar, being in fact a body of specialists whose duty it is to recommend what shall be termed best practice.

The results of their labors are shown in the better designs and methods of construction in use today. While no one doubts that there has been decided improvement in railway construction in recent years, they need only attend a few conventions to be convinced of the part these conventions have taken in the advancement of more economical and substantial work.

The railroad managers for the most part are convinced of the benefits to be derived from these associations and are ready to do all in their power to strengthen them. A few managers have expressed their appreciation in words, but many others would do so if called upon. There can be no better encouragement than the ac-



SMOKEJACKS AND VENTILATORS ON ROOF OF ROUNDHOUSE, CHICAGO & WESTERN INDIANA R. R.

nowledged appreciation of the executive officers of the railroad companies.

An Efficient Smokejack

C. & W. I. R. R.

THE smokejacks, which are used in the Forty-ninth street roundhouse of the Chicago & Western Indiana Railroad, have given very good results. While they have only been in service a year, they are as good as the day they were put into use and have met satisfactorily all the requirements of the smokejack.

The construction of the jack is shown in the accompanying illustrations. All wood surfaces were given two coats of fire-proof paint before the plaster was applied. Inside of jack and under-side of hood have plaster on expanded metal lath. This plaster is a special compound, consisting of one part asbestos, four parts lime thoroughly slacked and strained, and four parts sawdust. The jacks are supported as indicated by means of 1-inch round rods.

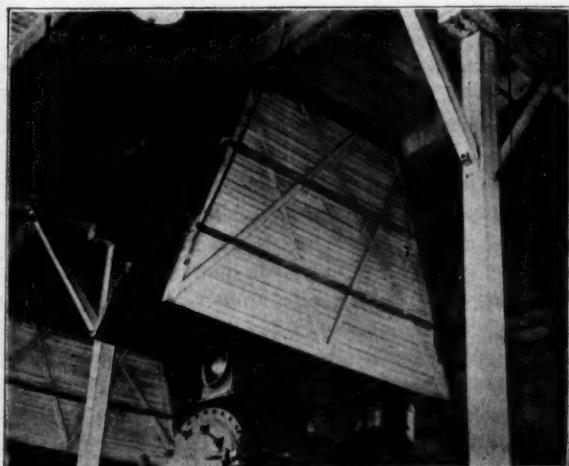
The damper inside of jack is closed when the jack is not in use in cold weather. There are also ventilators

in the roof of the roundhouse to regulate the heat and air.

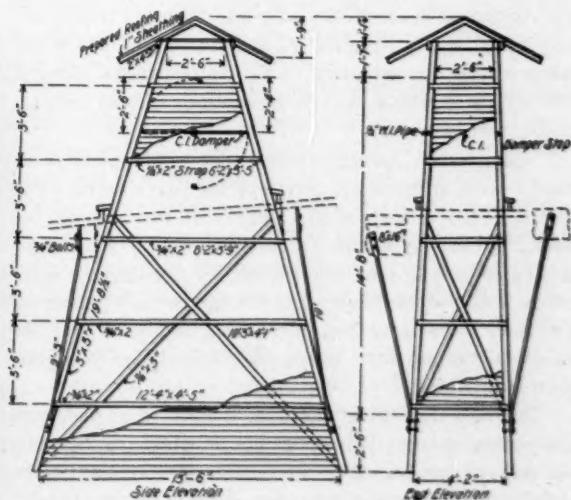
These ventilators are over the steam domes of locomotives as they stand on the pits and carry away excess steam from the pop valves, etc. It is readily appreciated that this arrangement is an efficient one in keeping the house clear of smoke and steam. The condition of the atmosphere of a roundhouse bears a direct influence on the movement of locomotives.

The jacks have not required a cleaning as yet. There is no danger from fire. The surface of the jack does not crack and no renewals of the lining have been made.

While no trouble has been experienced in the way of a smoky roundhouse, the jacks might be made wider to accommodate some engines. No serious objections, however, have been entered against this jack.



SMOKEJACK WITH LOCOMOTIVE STANDING BENEATH JACK,
CHICAGO & WESTERN INDIANA R. R.



SIDE AND END ELEVATIONS OF SMOKEJACK, CHICAGO & WESTERN
INDIANA R. R.

Convention of the Roadmasters and Maintenance of Way Association

THE twenty-fifth annual convention of the Roadmasters and Maintenance of Way Association was held on Nov. 12, 13 and 14, at the Sherman House, Chicago. After the meeting was called to order by President C. H. Cornell, Mr. R. H. Aishton, general manager, Chicago & Northwestern Ry., gave the opening address. He spoke of the standardization work of the association and its value to the railroads and also referred to the work that one association does in conjunction with others. Mr. Cornell in his address, which followed, made note of the fact that the members were assisted by the association in keeping abreast of the times.

The reading and discussion of papers followed. Each paper was fully discussed, and the opinions of many members cover their experience and the practice on their roads.

HOW TO MAINTAIN TRACK AND KEEP IT IN LINE AND SURFACE DURING THE WINTER MONTHS.

A report on the subject of maintenance of track in winter was submitted by Mr. C. H. Cornell, Chicago & Northwestern, in which he recommends the use of shims where the soil varies greatly in character and perfect drainage is not had. Extracts from this report are as follows:

"In January, February and March frost enters the ground to a depth of from three to six feet and maintenance of line and surface becomes difficult. In such territories it is a common thing for five or six feet of track to rise suddenly one or two inches above the normal level in a single day or night. It is not uncommon to have a continued rise within a distance of ten or fifteen feet that will, in a few days, reach a maximum of five or six inches.

"Of course it is out of the question to run trains safely at schedule speed over such abrupt and excessive humps. 'Gradual run-offs' must be introduced on either side of the high spots, but the ties being frozen solid in place and the ballast being frozen so solidly together that it can only be picked in irregular sized hard lumps, which are inappropriate for surfacing, it is manifest that making a 'run-off,' as it would be done in summer, is both impracticable and expensive."

"Again, when spring arrives, this would make soft, mushy spots at the worst period of the year's work. The ties if adzed to reduce the heights of the rails at the point of heaving would be ruined. So, in such cases it is customary to raise the 'run-off' by drawing the spike on each side of the high spot, letting the rails spring up part way to surface, then introducing shims between the rails and the ties until a 'run-off' of fairly uniform surface is provided.

"The rails then being raised, as it were, upon pedestals, are not so strongly held to gauge as when resting upon the ties and are braced on the outside with special braces, usually devised by the ingenuity of the foreman or roadmaster to fit the individual case.

"Shims are sawed from hard wood, seasoned and clear. They are bored with holes for the spikes, holes being staggered, two or four holes, to fit different widths of rail base.

"For shimming to a raise of $\frac{1}{4}$ inch, area of shims is $4\frac{1}{2} \times 8$ inches; raise of $\frac{1}{2}$ inch up to $1\frac{3}{4}$ inches, area 5×8 inches, and above that height up to 3 inches, area 5×12 inches. When necessary to shim four inches or higher a plank of about the same area as the surface of the tie and extending almost or quite the length of the tie, should be used, and it should be fastened to the tie with bolt spikes. The rails should be spiked through the shims to the ties with 8 inch spikes.

"To brace the rails on shims cut a light notch outside of the rail transversely across the tie, put a shim two or three inches thick with one end against the shoulder of the notch and the other a close fit at the fillet where the head and web of the rail meet and drive 8 inch spikes into the tie at the lower end of this make-shift brace.

"I know that all I have said so far is with reference to ways and means to do things that it really ought not to be necessary to do. In other words, these are ways of meeting conditions that ought not to exist. There are three better ways to maintain line and surface in winter. The first is good drainage; the second is better drainage, and the third is perfect drainage."

While it was the general opinion of the members that heavy ballasting and good drainage should be used to do away with shimming, it was agreed that shims are often necessary. When shims exceed $\frac{1}{4}$ inch they should be bored; a motion to this effect was carried. When the shims are less than $\frac{1}{4}$ inch they are made with a hand-axe and nailed to the ties instead of bolted. On some roads, the shims from $\frac{1}{8}$ to 1 inch in thickness are bored, sawed and packed in the shops and then sent out to the sections.

METHOD OF DESTROYING VEGETATION IN TRACK, INCLUDING WEED BURNERS.

A report on the subject of methods of destroying vegetation in track was submitted by Mr. J. M. Guffey, Atchison, Topeka & Santa Fe. Extracts from the report are as follows:

"During the last year I had about 35 miles of dirt track with a rich sandy soil that will grow about as good a crop of weeds and grass as I have ever had to deal with. It is in a hilly country where it is necessary to keep the track almost clear of weeds and grass, and we have to keep it cut about six months in the year. In the spring when the weeds and grass get up high enough to give us trouble, we take our shovels and cut the grass from the ends of the ties and between the ties from the outside, and only cut inside the rails as far as the shovel will cut by running the shovel under the rail between the ties. This can be done at a cost of about \$7.50 per mile. We then leave the grass go until it gets up again. We repeat this about every six weeks, just cutting the grass

from the outside until about the first of October; we then cut it clean, inside and outside, at a cost of about \$12.50 per mile. Three cuttings at cost of \$7.50 each, would be \$22.50 and the final cutting at \$12.50 would make total cost for the year of \$35 per mile. This will keep the grass out of the way of trains, but will not keep the track clean, as this provides for a thorough clean up once a year only. To do this work we use a light steel shovel with a handle about 3 feet 10 inches long."

The discussion of this paper referred particularly to the use of weed-burners. Many western roads have found the weed-burner to be very economical and to give satisfactory service. The cost is at the most about $\frac{1}{4}$ of the amount expended in hand labor and there is also a large saving in time. The cost of hand-labor cutting is a variable quantity, depending upon the kind of vegetation, cost of labor, etc.

WRECKING OUTFITS, ORGANIZATION AND WORKING.

The paper on the organization and working of wrecking crews was submitted by a committee composed of the following members: C. Buhler, L. S. & M. S. Ry.; W. H. Kofmehl, C., M. & St. P. Ry.; A. Boydston, A., T. & S. F. Ry., and B. A. West, A., T. & S. F. Ry. The report was discussed by paragraphs and was accepted with several amendments, one being an insertion in the second paragraph of the phrase, "roadmaster during the absence of the superintendent," for the word superintendent. The report is as follows:

"Your committee believe that the wrecking crews should be in charge of the mechanical and car department, as men employed in the mechanical and car departments are more able to handle derailed and wrecked engines and cars than other classes of railroad employees. The wrecking crews when out on the road and at wrecks should be under the authority of the roadmaster during the absence of the superintendent on the division the wreck is on, co-operation of the employees and heads of different departments are needed to facilitate the clearing of wrecks, and repairing the damaged track, in order to reopen the road for traffic as quickly as existing conditions will permit.

"At each division headquarters on busy trunk lines where traffic is heavy and fast, a wrecking outfit and crew should be located. Such outfit should consist of a 50 or 75 to 100 ton steam wrecking derrick; one tool car to contain all necessary tools and blockings; one car for track material; one car for extra trucks, and one commissary car supplied with a cook stove. Total, one steam derrick and four cars.

"The wrecking outfit should be in charge of a good wrecking master and ten competent car repairers. The steam derrick should be in charge of a good engineer and fireman. At points of wrecks, in addition to these two men, a good reliable man should be stationed on the steam derrick to take the orders and signals from the wrecking master, and give them to the engineer, as the engineer in charge of the steam derrick cannot hear the orders and see the signals given by the wrecking master

and attend to the swinging of the derrick boom and other work required from the steam derrick.

"The steam derrick and cars belonging to the wrecking outfit should be placed on a special track at division headquarters. A track that at no time will be blocked, but that can be approached at all times quickly with an engine, so there will be no delay caused at the starting point by not getting the wrecking outfit ready to start on short notice.

"In order to always have the proper force ready for the wrecking crew, the master wrecking foreman, as well as the men needed for assistance, should be employed in the car department at their shops or repair yards. The engineer and fireman for the steam wrecking derrick should be employed either at the engine house or machine shop, in order that they can be called on short notice in case of wrecks. The wrecking crew should be called by telephone, electric bells and swift callers.

"Wrecking trains should be taken to points of wrecks by first engine and train crew available.

"For lighting up wrecking operation at night, the David acetylene lighting system attached to the derrick boom seems to be the best light so far used; however, the Wells light, the Buckeye light, torches and Dietz lanterns will supply good light.

"For emergency use, a sufficient supply of canned goods and coffee should be kept in the commissary car, so that in serious wrecks the wrecking force can be supplied with lunch, until such time as the men can be conveniently spared to go to regular hotels for meals. If the roads are so located that hotels or eating houses are far apart, meals should be provided in the commissary cars for the wrecking crews.

"The head of the track department and the section foreman of the division on which the wreck occurs should be advised by the train dispatcher as promptly as possible of the nature of the wreck as reported to him by the train crew in charge of the wrecked train, so that the head of the track department can order out to points of wreck whatever track men may be needed to take care of the damaged track and give the wrecking crew what assistance they need.

"The wrecking outfit should be provided with a good supply of different size pine and oak blockings from 1-inch plank to 2, 3 and 6-inch and from 24 to 36 inches long, and a supply of wooden wedges of different sizes.

"Four to six 20 to 50-ton jacks should be kept in the tool car. However, with a 75 to 100-ton steam wrecking derrick, jacks are not needed or used much, the steam wrecking derrick doing the work much quicker than jacks would.

"Four $\frac{3}{4} \times 15$ foot truck chains with a grab hook at each end and a ring in the center should be kept in the tool car. Two large and two small grab hooks to be used to turn over car frames and car bodies are much-needed articles in connection with the steam wrecking derrick, as with the proper constructed grab hook attached to the cable of the steam wrecker and grab hook properly placed

a box car body can be rolled over very quickly to clear obstructed tracks. At least 20 chains from, $\frac{5}{8}$ -inch, $\frac{3}{4}$ -inch, $\frac{7}{8}$ -inch and 1-inch, 15 feet in length, should be kept in the tool car to be used in chaining trucks to body of cars and lifting them and chaining cars together, where draft rigging and couplers are broken. In addition to these chains there should be at least 6 chains $1\frac{1}{4}$ -inch in diameter and 20 feet in length, needed to make heavy lifts. There should be four wire cables 2 inches by 20 feet in length, needed to roll and lift cars and engines. There should be at least four hemp ropes from 1 to 3 inches in diameter and from 200 to 300 feet in length, with the proper size snatch blocks fitting these ropes. There should be two guy anchors, four wrecking frogs, a good supply of tools, such as sledges, chisels, hammers, wrenches, as may be needed to disconnect bent and twisted rods. There should be carried in the wrecking car a full set of track tools, such as claw bars, lining bars, spike mauls, track wrenches, track chisels, shovels, picks with handles and track gauges for emergency cases. Scoop shovels and baskets and bags to handle and transfer grain.

"The car with track material should be supplied with 20 rails and fastenings for same, of the pattern used on main line, 1 switch complete, 1 R. H. and 1 L. H. spring frog of same angle used on main line, 2 guard rails, 100 to 150 ties, 5 kegs spikes and 2 kegs of bolts.

"Your committee believes that the first aim in case of wrecks should be to clear the tracks and reopen it for traffic. After traffic is moving the wreck should be picked up, cars unfit for future use burned and scrap picked up as soon as possible after wreck has occurred, as portion of wrecked cars looks very unsightly along railroad tracks."

"Damaged freight should be reloaded and turned over to the claim department for adjustment. In serious accidents where a large amount of freight has been damaged or stock killed or injured, the claim department should be advised so they can have one of their agents on hand at place of wreck.

"In passenger wrecks the first aim should be to take care of the injured persons. Your committee can recall cases where farmers along the line of road have given valuable assistance in case of passenger wrecks by taking care of injured persons until medical assistance could reach them. Medical assistance should be called from the nearest villages and cities near which the wreck occurs, and every possible effort should be made to get the most available physicians to point of wreck as quickly as possible. The wrecking outfit should also be supplied with two or more stretchers and blankets to carry injured persons to place of safety. The most difficult problems often presenting themselves are that very seldom two wrecks occur alike. It requires the best of judgment and mechanical skill to handle the wrecks of different nature with facility and promptness and reopen the blocked road with promptness."

COST OF BALLASTING OLD TRACK AND RENEWING TIES.

The report on cost of ballasting old track and renewing ties was submitted by a committee composed of the following members: A. E. Hanson, C., & N. W. Ry.; C. Buhrer, L. S. & M. S. Ry., and J. W. Guffey, A. T. & S. F. Ry. The report of the committee is as follows:

"It costs on a Northern Division of the C. & N. W., to ballast a mile of track with unscreened and unwashed ballast, gravel, just as you get it out of the pit, figuring on a 12-inch raise, with a standard gravel road-bed on the top of 11.6 inches, slope $1\frac{1}{2}$ to 1 on the bottom, 16 feet from ballast line to ballast line, as follows:

Cost of gravel loaded on cars in pit, cu. yd....	\$0.07
Hauling and unloading, 50 mile haul.....	.10 2-3
Ballasting .....	.12 1-3

Cost per cu. yd. \$0.30

Figuring on using 3,400 cu. yds. per mile, it will cost \$1,020.00 for one mile of finished work with this kind of ballast.

"The question of tie renewals in ballast of the same description figuring on 425 ties per mile, evenly distributed over the entire mile, where track is in such condition that resurfacing is not necessary and the old ties have to be dug out of the road-bed and new ties inserted, properly tamping with either tamping bars or picks, the road bed properly dressed and old ties gathered up and neatly piled, it will cost \$0.16 1-7 per tie.

"On a division of the L. S. & M. S. Ry. for the year 1906, the cost of ballasting was as follows:

	Per yd.
Gravel, washing and loading	\$0.18
Cost of hauling .....	.07
Cost of digging out old ballast .....	.15
Cost of unloading and placing in track.....	.15

Total	\$0.55
Per yd.	

Crushed lime stone, $\frac{3}{4}$ to $1\frac{1}{2}$ inch in size:

Cost of stone	\$0.535
Cost of digging out old ballast.....	.15
Cost of hauling, unloading & placing in track.....	.40

Total	\$1,085
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Renewing ties cost us \$0.138 per tie in gravel ballast.

On a division of the Santa Fe the cost was as follows: Our ballast crushed stone costs us at the crusher, loaded on cars, per cu. yard..... \$0.61 $\frac{1}{2}$
Cost for a 50-mile haul per cu. yd. 05 $\frac{1}{2}$
Using Mexican labor cost to insert..... .33

Total cost per cu. yd.....	\$1.00
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"For a 12-inch raise we use 3,400 cubic yards per mile, making a total cost per mile of \$3,400.00. We have tried sloping our ballast, with a scant shoulder for several years, but found it impossible to keep our track in line and surface, and consequently changed to the present standard, which requires the ballast dressed level with

the top of the ties for the full length of the tie and extending 6 inches beyond the ends of the ties, making the top width of the ballast 9 feet and giving it a slope of $1\frac{3}{4}$ to 1; this gives a road-bed 16 feet wide from ballast line on one side to ballast line on the other side, with a 12-inch raise.

"We use the center-drop Rodgers ballast cars, 80,000 capacity, drop the ballast in center of track and use center plow for plowing the ballast off the track; this leaves the track clear. The \$3,400.00 per mile would cover all costs for the ballast and inserting the ties, where we would not have to use more than 425 ties per mile. It is very expensive work renewing ties in track that has been ballasted in this way. I find that in renewing ties in the track where the track is up to grade and we cannot give it a raise, it costs about 25 cents per tie to renew the ties. It will cost approximately 25 cents to dig out an old tie, insert the new one, tamp it up properly, spike it and dress the track up as we found it leaving it in first-class shape. Of course where the track had got to be resurfaced we can remove the old tie and insert the new one for about $8\frac{1}{3}$ cents per tie."

Washed gravel gives a dustless track because the impurities, such as clay and sand, are washed out. The washed gravel is handled with shovels. The only screening is done in the washer. Washed gravel ballast holds well, but at the present time it is customary to use larger shoulders on the roadbed with this ballast.

The question of wages was brought up and it was learned that on the Lake Shore and Michigan Southern the cost of labor was \$1.60 per day with foremen from \$60 to \$75 per month; on the Chicago and Northwestern \$1.75 for labor per day with foremen about \$80 per month, and on the Atchison, Topeka and Santa Fe \$1.50 for labor per day with foremen about \$80 per month.

ORGANIZATION AND WORKING OF A RELAYING GANG.

A report was submitted by Mr. J. Kennedy, M., St. P. & S. S. M. Ry., on the subject of relaying rail. The amended report is as follows:

"All rails to be laid one at a time, except in a yard where business is too heavy to permit the use of the tracks. Men in rail-laying gang must be organized so each man knows his own work.

"Necessary adzing should, if possible, be done in advance of rail laying by section men or other men for that purpose, as this is the heavy item of rail laying on nearly all roads.

"All ties to be plugged where spikes are pulled, adzed so as to give the wheel and rail base a proper bearing. A push car should always be kept in the rear of rail gang to carry joints and other necessary tools for closing up quickly."

"Fifty or more men should constitute a rail-gang and there should be a general foreman, two assistant foremen and a timekeeper.

"All rail should be full-bolted and full-spiked the same day it is laid.

"Train dispatcher should be notified the evening before between what points working. On a heavy railroad a

telegraph operator should be with the rail laying crew to keep foreman posted as to belated trains.

"The unloading of rails should be done with great care so as not bend any rails. And all rails should be unloaded as near in place as possible for laying. Thermometer and steel expansion shims to be used. The expansion must be kept in good shape. We will not give expansion dimensions, as nearly every road varies as to this one point; each road has a standard of its own.

"A switch point can be used to close up temporarily for the passage of trains, but in using a switch point the foreman must use great care and see that his stock rail is on a level with the switch point, as the committee has seen a very serious derailment by an engine trailing through a switch point while relaying rail, and we would recommend that the rail be cut at night, closed up and full-bolted for the passage of trains at regular speed.

"Where rail of different sizes is being used, compromise joints or tapered rails must in all cases be used for the safe passage of trains.

"We would also recommend that nut locks be used on all rail, as without using nut locks the bolts that are furnished today cannot be kept tight.

"All rail to be gauged as fast as it is laid; full spiked, and any joint ties that are low should be either shimmed up or tamped up."

In the discussion of this paper, the question of when and how ties should be adzed was carefully considered. Mr. Boydston said that he found that, if the ties were adzed by unskilled labor, the hard ones were not cut enough and the soft ones received more than their share. He advanced the proposition to adze the ties with several good men, adze so as to cant the rail and follow up with the steel gang. One objection to canting rails by adzing is that new ties would have to be adzed. Other members do not believe in leaving a shoulder on the old ties to cant the rails, but that the shoulder should be cut away. Mr. Boydston said that he could finish up from 3,000 to 4,000 track ft. in one day with a gang of 75 Mexicans without spacing ties.

The cost per mile of relaying old rail was given by Mr. Hanson as \$348.98 per mile of finished track. The cost, however, is variable as there are many conditions upon which the speed of the work depends. For instance on a branch line the work could be done at a lower cost because, in the first place, the work would not be frequently interrupted by trains.

A paper was written by J. C. Rockhold, A., T. & S. F. Ry., on the subject, "The Oiling of Roadbed," and read at the convention. The oil is applied by a sprinkling car, running at the rate of about 4 miles per hour. Sixty barrels of crude oil are used per mile at a cost of 18 cents per barrel or about \$11 per mile.

Mr. Camp, editor, Railway and Engineering Review, read a paper on the subject, "Why Efficient Track Work is Skilled Labor," which proved very interesting. He spoke of the demand for better track which made skilled labor all the more necessary. He advocated an increase in wages in order to hold the laborers and the

training of certain laborers to take up a foreman's duties.

The next annual meeting will be held in Milwaukee, Wis., on Nov. 12, 13 and 14. The officers, elected for the ensuing year, are as follows:

President, J. A. Kerwin, Mo. Pac., Chester, Ill.

First Vice President, A. E. Hansen, C. & N. W., Green Bay, Wis.

Second Vice President, W. A. Brandt, C. & N. W., Antigo, Wis.

Secretary and Treasurer, W. E. Emery, C. & A., Kansas City, Mo.

Executive Officers, B. A. West, C. Muschott, W. H. Kofmehl, T. Thompson and C. H. Cornell.

The firms, who exhibited at the convention, are included in the following list:

Adams & Westlake Company, Chicago, Ill.—Switch, semaphore and other signal lamps. Represented by G. L. Walters and H. G. Turney.

American Flange Frog & Improvement Company, St. Louis, Mo.—Models of the Graham flange frog, spring and ridged, no guard rail. Represented by M. Greenwood, Jr., Dr. C. B. Strous and J. M. Rice.

American Hoist & Derrick Company, St. Paul, Minn.—Photographs of the American ditchers in operation. Represented by F. J. Johnson.

American Rail Joint Company, Toronto and Buffalo.—Models of the American rail joint. Represented by W. H. Scofield.

American Railway Device Company, Chicago, Ill.—Economy separable switch points, Odenkirk switchstands, anti-rail creepers. Represented by O. Metcalf, Jr.

American Steel & Wire Company, Chicago.—Right of way fencing, samples of wire rope, rail bonds and electrical wire. Represented by J. M. Hollaway and L. P. Shanahan.

American Track Barrow Company, The, Lowell, Mass.—Models of track barrows and rail pony cars. Represented by A. C. Buck.

American Valve & Meter Company, Cincinnati, O.—Two Economy switchstands and catalogues of Poage water columns. Represented by F. C. Anderson.

Atlas Railway Supply Company, Chicago, Ill.—Atlas rail joints, braces and tieplates, Atlas improved switchstands. Represented by J. G. McMichael and J. M. Huber.

Blessing, Louis, Jackson, Mich.—Cable loop reinforced concrete ties and adjustable keyed nut lock. Represented by Louis Blessing and Alfred Johns.

Border Bolt & Nut Lock Company, Richmond, Ind.—Samples of bolts and nut locks. Represented by W. H. Hobin and William L. Lawler.

Buda Foundry & Manufacturing Company, The, Chicago, Ill.—Jacks, drills, wheels, switchstands, gauges, levels and tool grinders. Represented by V. A. Swett, J. T. Harahan, Jr., R. W. Smith, Snyder Dyer.

Cleveland Frog & Crossing Company, The, Cleveland, O.—Samples of Prentice anti-rail creepers as applied on track. Represented by George Stanton.

Commonwealth Steel Company, St. Louis, Mo.—Photographs and pamphlets showing cast-steel gasoline weed burner. Represented by Frank S. Barks.

Cook's Standard Tool Company, Kalamazoo, Mich.—Track drills, track tool grinders and cattle guards. Represented by Eugene Cook.

Coulter & Paxton, Longmont, Colo.—Models of improved track wrench and clamp. Represented by C. J. Coulter.

Dilworth, Porter & Co., Ltd., Pittsburg, Pa.—Samples of Glendon flange and Goldie claw tieplates. Represented by Charles Stein.

Eyeless Tool Company, The, Newark, N. J.—Eyeless picks and track tools. Represented by M. F. Wood.

Fairbanks, Morse & Co., Chicago, Ill.—Motor car size O, Barrett track jack and rail drills. Represented by A. A. Taylor, C. W. Kelley, E. O. Reynolds and W. G. Willcoxsen.

Gibraltar Manufacturing Company, Chicago, Ill.—Model of Gibraltar bumping post. Represented by Charles L. Brackett.

Goldie, William, Jr., & Co., West Bay City, Mich.—Goldie perfect tie plugs. Represented by William Goldie, Sr.

Grip Nut Company, Chicago, Ill.—Samples of grip nuts, both square and hexagon. Represented by E. R. Hibbard, B. F. Stewart and Charles Ward.

Hart Steel Company, Elyria, O.—McKey rolled steel shoulder tieplates and open hearth steel spikes. Represented by W. S. Miller, W. T. Bentz, Guilford S. Wood and A. W. DeRocher.

Hayes Track Appliance Company, Geneva, N. Y.—Hayes derails, with operating and target stands. Represented by S. W. Hayes and H. S. Nester.

Hussey Binns Shovel Company, Pittsburg, Pa.—Shovels, spades and scoops. Represented by Joe H. Martin.

Kalamazoo Railway Supply Company, Kalamazoo, Mich.—No. 1 standard section hand car, No. 13 velocipede car (wooden type), No. 0 steel velocipede car, No. 1 Moore track drills, also No. 2 and No. 3, Kalamazoo track jack, gauges and levels, Smith's curve lining gauge, also pressed steel wheels. Represented by John McKinnon and W. I. Clock.

National Lock Washer Company, Newark, N. J.—Nut locks and bolts. Represented by John B. Seymour, G. E. Bake and T. B. Buss.

Pennsylvania Steel Company, Pittsburg, Pa.—Manard manganese anvil-faced frog, design 160. Represented by R. E. Belknap, J. H. Allen, H. D. Bixby and M. E. Salsich.

Quincy-Manchester-Sargent Company, Chicago.—Bonzano rail joint, Q & C compromise joint, Q & C insulated joint, Q & C Cafferty tie tongs, L. & S. Racine, Q & C bulldog anti-rail creepers. Represented by George C. Isbester, B. F. Lewis, George T. Briggs.

Rail Joint Company, The, New York, N. Y.—Improved rail joints of continuous Weber and Wolhaupler types. Represented by D. J. Evans, W. E. Clark, G. A. Hagar.

Railroad Supply Company, Chicago, Ill.—Tie plates and derailers. Represented by E. H. Bell, C. Cogswell, W. M. Smith, M. Comerford.

Railway Specialty & Supply Company, Chicago, Ill.—P. & M. rail anchors, Smith improved nuts, vice grip rail anchors, combination tieplate guard rail brace. Represented by F. A. Preston and P. W. Moore.

Ramapo Iron Works, Hillburn, N. Y.—Represented by Arthur Gemunder.

Riley, M. M., Ironwood, Mich.—Model of steel tie and rail. Represented by M. M. Riley.

Scott, John M., & Son, Racine, Wis.—Models of Hercules and Little Giant bumping posts and Racine nut locks. Represented by John M. Scott and E. E. Scott.

Sellers Manufacturing Company, Chicago, Ill.—Tie plates, rail joints, splice bars. Represented by John M. Sellers and Joseph T. Markham.

Stover Motor Car Company, Freeport, Ill.—Gasoline motor car. Represented by M. Mowbray.

Thomas Boltless Rail Joint, Watertown, Wis.—Model of boltless rail joint. Represented by W. R. Thomas.

Universal Portland Cement Company, Chicago, Ill.—Samples showing different stages in the manufacture of Portland cement. Represented by W. D. Tracy and W. T. S. Thackara.

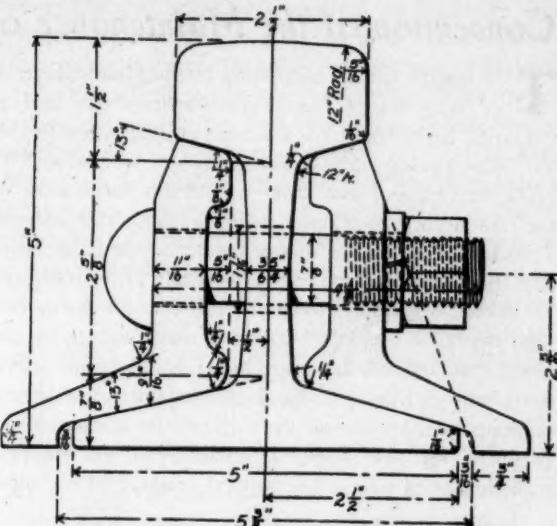
United States Wind Engine & Pump Company, Batavia, Ill.—Switchstand, semaphores and water supplies. Represented by R. E. Derby and C. E. Ward.

Worth Wire Works, Kokomo, Ind.—Wire fence stays. Represented by C. A. Butler and O. H. Buck.

Realignment and Double Tracking

ON the Norfolk & Western Railway, between Forest and Montvale, double tracking has been completed. The ruling grade on the new line is 5-10 per cent against east-bound traffic and 7-10 per cent against west-bound traffic. The maximum curvature on the new double-track line is 4 degs. The railroad in this entire district crosses all the streams in the country, making construction work quite heavy.

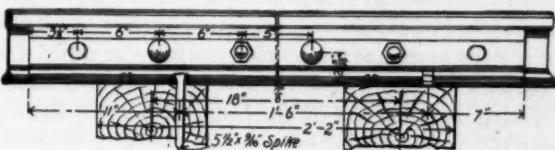
The Long Island Railroad will use concrete pile foundations for the new conduit line in the North Shore Yards at Long Island City. The contract has been awarded the Raymond Concrete Pile Company, of Chicago and New York, by J. R. Savage, Chief Engineer. The conduit, which will be of concrete, will be 1,100 feet long and will carry the feed wires for the electric system. The application of concrete piling to conduit foundations is a novel one, this being the first time such use has been made on a contract of any magnitude. The Abbott-Gamble Company are the general contractors.



RAIL AND JOINT, STANDARD TRACK DETAILS.

Standard Track Details, C. & W. I. R. R.

IN THE accompanying drawings, the standard rail and joint in use on the Chicago & Western Indiana Railroad are shown. The rail is of 80-pound section and the joint is designed to fit same. The dimensions are given in detail.



SIDE ELEVATION OF RAIL JOINT, STANDARD TRACK DETAILS.

The rails are of 30-foot length and are set on 6x8-inch by 8-foot ties placed 20 1/4 inches on centers, except at joints where the ties are 18 inches on centers. The double track roadbed is 33 feet in width with 10 inches of broken stone ballast under the center of ties. The roadbed is on a 20 to 1 slope, giving less ballast under inside end of ties and more under the outside end. The centers of track are 13 feet apart.

Construction on Alaska Central Railway

ON the Alaska Central Railway, rock work is continued throughout the year and is handled in the same way as in warmer climates. Gravel and dirt work is only carried on during the summer season of about six months.

The ballast used on this road is a glacial drift gravel, generally gray wacke. The ties are spruce, native, pole ties, which are giving good service, but require tie plates on sharp curves. The rail is the 65-pound A. S. C. E. standard. We are indebted to J. B. Cameron, engineer of construction, for the above information.

Convention of the Maintenance of Way Master Painters' Association

THE fourth annual convention of the Maintenance of Way Master Painters' Association was held at the Great Northern Hotel, Chicago, on November 19 and 20. The opening address was given by Capt. Robert W. Hunt, of Chicago, who spoke of the successful work of the railroad organizations. Following upon this address, President A. B. Phelps, master painter of the Lake Shore and Michigan Southern, gave a short talk to the members. He asked the members to enter freely into the discussions with the "give and take" policy as their motto. He advised that aim of the association should be to secure uniformity in work. In speaking of maintenance of way painting he thought that there should be a separate department for this work, accountable to the engineer maintenance of way or the general or assistant manager.

OBSERVATIONS FROM PRACTICAL BRIDGE PAINTING EXPERIENCE.

A paper was submitted by J. R. Shear, Pacific Electric Company, Los Angeles, Cal., upon the subject of bridge painting. In his paper he dealt with the causes for the failure of paint on iron bridges and the remedies, which were reasoned out by him from practical experience. An abstract of certain sections of the paper is here given.

The future of the bridge depends upon the thoroughness of the cleaning before the first coat of paint is applied. Most bridge members receive a coat of linseed oil or red lead at the shops. The writer prefers oil because it is transparent and allows rust or dirt to be easily seen, and then, too, the coat of red lead at the shops is usually nothing more than an oil stain which covers all signs of rust.

The sand blast is the only effective way of removing light rust stains. The writer recommends the use of red lead for the first coat, as it withstands the action of the gases and keeps the moisture away. The liability of red lead to run can be removed by mixing the dry red lead with boiled oil and adding about one-fourth white lead and a little dryer. The white lead holds the red lead in suspension and keeps it as dry and hard as flint.

A practice, which is detrimental, is to allow cinder and ashes to collect on abutments until the bridge seat is buried. An acid is formed by the water and cinders, which no paint can withstand.

PAINTING STRUCTURAL IRON.

The subject of painting structural iron was treated in a paper submitted by Harry Chapham, foreman painter of the Louisville & Nashville. He advocated that the iron should not be painted in the shops, but should be given the first paint by the maintenance-of-way painter in order to secure more careful application of the paint.

PAINT STOCK ON THE ROAD.

The paper on the subject, "Paint Stock on the Road," was presented by H. J. Barkley, Illinois Central, Fort Dodge, Ia. An abstract of certain sections is here given.

The most satisfactory way of supplying paint for a job is by means of a car with the necessary tools and

paint or, in other words, a paint shop on wheels. Tanks for turpentine, oil and other supplies, and secure racks for barrels will be had and thus the rough handling on trains will be avoided.

The standard colors should be mixed before being sent to the crews. This avoids the difficulty and expense arising with unexperienced men in the absence of the foreman.

The practice on the Illinois Central is to send a stock of material in the cars as nearly suitable for the work as possible. The crew can then finish up a piece of work on short notice. This method has been the means of saving in expense and convenience.

Following the discussion of the preceding papers, J. H. Hirst, president of the Hirst & Begley Linseed Company, presented a paper on linseed oil, in which he spoke of the manufacture and character of the oil on the market today.

A paper was read by W. B. Morgan, master painter of the Pennsylvania Lines West. He related his experiences in cleaning and painting steel bridges.

It was decided at the convention that the most desirable method of painting steel bridges is not to give a shop coat of paint, but to allow the mill scale to disappear in the course of several months and then to apply two coats of paint in addition to the first coat, which is now termed the shop coat.

Red lead was suggested as the most desirable paint and it was also stated that mineral red gives satisfactory service.

The old officers, re-elected to serve for another year, are as follows:

President, A. B. Phelps, Lake Shore & Michigan Southern, Cleveland, O.

First Vice-President, W. I. French, New York, Ontario & Western, Middletown, N. Y.

Second Vice-President, M. F. Ebel, Cincinnati, Hamilton & Dayton, Hamilton, O.

Secretary-Treasurer, H. J. Schnell, 100 William street, New York.

It was decided to hold the next convention at St. Louis, Mo., on November 17 and 18, 1908.

The following is the list of supply houses represented and the names of their representatives:

Akron Mining, Milling & Manufacturing Company, Aurora, Ill.; F. L. Harkness.

Ball Chemical Company, Pittsburg, Pa.; C. O. Taylor.

Berry Brothers, Detroit, Mich.; George M. Kerr.

Detroit Graphite Company, Detroit, Mich.; S. L. Brown and L. Mitchell.

Dixon, Joseph, Crucible Company, Jersey City, N. J.; E. R. Smith.

Lowe Brothers Company, Dayton, O.; John D. Ristine.

Mamolit Carbon Paint Company, Cincinnati, O.; C. D. Fashel.

National Paint Works, Williamsport, Pa.; W. B. Parker.

Semet-Solvay Company, Syracuse, N. Y.; H. G. Carrel.

Wadsworth-Howland Company, Chicago, Ill.; R. T. Brydon.

White Lead & Oil Company, Chicago, Ill.; W. G. Thomson.

Strength of Structural Timber

THE second progress report on the strength of structural timber by Prof. W. Kendrick Hatt, civil engineer, Forest Service, is embodied in Circular 115 of the U. S. Department of Agriculture. Extracts from the report are given in the following paragraphs:

There were two general classes of tests: (a) Tests on large beams, for studying the relations between strength, defects and degree of seasoning, and for determining moduli for design; (b) tests on small pieces cut from the uninjured parts of the tested beams. The latter, classed as minor tests, include bending, compression parallel to grain and at right angles to grain, and shearing. Minor tests are used to study the effects of moisture, rate of growth, and other factors. In such studies defects must, as far as possible, be eliminated.

Tests of class *a* were made upon large sticks, such as bridge stringers and other structural timbers having such knots, crooked grain and other defects as are found in market material.

The attention of shippers is called to the weights of the different materials given in the tables. The weight of air-dry material, as found upon the market, varies considerably, but as a rule it will exceed the oven-dry weight given in the tables by from 15 to 30 per cent, according to size and species. The oven-dry weight is obtained from the weight and from the volume measurements of the timber at the time of test, in conjunction with subsequent moisture determinations. The shrinkage of the timber is not taken into account. This is variable and at present is not accurately known. It is estimated that air-dry timber has lost about 5 per cent of its green volume.

The actual weight of the wood at the time it was tested may be computed from the oven-dry weight and moisture per cent. Thus, a dry weight of 29.4 pounds per cubic foot, at a moisture per cent of 19.4, gives a weight of 35.1 pounds per cubic foot at the time of the test. The measurements of volume were, in most cases, those of surfaced lumber.

A digest of the results of bending tests on large sticks given in the tables is shown in Table 1, which indicates the weight, strength, and stiffness of beams, such as are found on the market and used by engineers. The modulus of rupture represents fairly well the strength of the timber; the modulus of elasticity represents its stiffness. It should be noted that the strength values of wood usually quoted in handbooks are based on small, clear, well-seasoned sticks, the strength of which largely exceeds that of large structural timber.

The moisture condition of the beams varied somewhat

between the different species given in Table 1. The moisture content of green timber also varies with the species—for instance, the maximum is about 37 per cent of the dry weight in the case of Douglas fir heartwood and as high as 100 per cent in the case of loblolly pine sapwood, so that the same moisture per cent in these two woods does not represent an equal degree of seasoning. Again, Douglas fir seasons more rapidly in the dry climate of California than does loblolly pine in the moist climate of the Atlantic coast.

Refer- ence No.	Species and locality of growth.	Grade.	Condition.	Num- ber of tests.	Mois- ture per cent.	Weight per cubic foot.		Modu- lus of rupture.	Modu- lus of elasticity.
						As tested.	Oven- dry.		
LOBLOLLY PINE.									
1	South Carolina.	Square edges.....	Green.....	42	48.0	12s. 45.2	12s. 31.2	1,772s	1,400 Ibs. per sq. in. 1,400
LONGLEAF PINE.									
2	South Carolina and Georgia.	Merchantable ..	Partially air dry.	44	26.1	49.8	36.5	7,772s	1,000
DOUGLAS FIR.									
3	Oregon and Washington.....	All grades.....	Partially air dry.	216	22.1	33.8	27.7	6,975s	1,000
4	.....do.....	Select and mer- chantable.....	.....do.....	194	22.0	33.9	27.7	7,000s	1,000
5	Oregon.....	All grades.....	Green.....	135	30.9	38.4	29.4	6,140s	1,000
6	.....do.....	Select and mer- chantable.....	.....do.....	108	31.3	38.6	29.4	6,400s	1,000
WESTERN RED- LOCHE.									
7	Oregon and Washington.....	All grades.....	Partially air dry.	66	27.8	33.2	36.0	6,960s	1,381
8	Washington.....	.....do.....	Green.....	30	36.2	38.8	38.8	6,700s	1,475
TAMARACK.									
9	Minnesota.....	Merchantable ..	Green.....	30	35.6	45.2	30.1	6,000s	1,210
NORWAY PINE.									
10	Minnesota.....	Merchantable ..	Green.....	49	47.8	37.4	36.4	3,975s	1,180

NOTE.—Figures written as subscripts to the figures for modulus of rupture indicate the number of sticks failing in longitudinal shear.

TABLE I.—SUMMARY OF THE AVERAGE BENDING STRENGTH OF STRUCTURAL TIMBER.

It is surprising how much moisture is found in well-seasoned timber. Sticks of longleaf pine 10 by 12 inches in cross section after drying in a lumber yard at Washington, D. C., for one year contained 35 per cent of moisture, and sticks of loblolly pine from Virginia, 8 by 8 inches in cross section, after drying in the same place for two years and becoming almost black on the surface, contained 34 per cent of moisture.

In small sticks the strength begins to increase after the moisture has been reduced to about 26 per cent. The laws expressing the relation of strength and moisture in the cases of small sticks do not, however, necessarily apply to large sticks. Timbers of commercial size develop checks and other defects while seasoning, and these partially offset the increase in strength due to drying. However, in the case of select sticks the actual strength was in some cases increased from 10 to 25 per cent by one year of careful seasoning.

LOBLOLLY PINE.

In the forest loblolly pine in prolific, grows vigorously, and holds its place in competition with other species. It is the principal tree in the operations of those lumber companies in the Southern States which look upon their forest holdings as part of their capital and reap successive crops from them by conservative forest management. It is therefore a timber which engineers and architects may expect to find on the market for an indefinite period.

The chief objection to it is that being largely sapwood it decays rapidly when exposed. Because of its open grain, however, it is a wood which may be treated very successfully with preservatives.

Some of the bending tests were made with the load applied at the center of the span, and the remainder with the load applied at points one-third of the span from each end. The modulus of rupture of the green North Carolina pine beams is 5,580 pounds per square inch, and the modulus of elasticity 1,426,000 pounds per square inch. In the case of the partially air-dried beams containing from 25 to 30 per cent of moisture, these values are 5,650 pounds per square inch, and 1,435,000 pounds per square inch, respectively. The oven-dry weight of the timber in both these groups is 31.2 pounds per cubic foot. The moisture per cent was 27.7 for the partially air-dried and 48 for the green material. Diagrams I and II show the distribution of moisture throughout the cross section of beams under different conditions of seasoning.

In the case of the partially air-dried beams containing less than 25 per cent moisture, the modulus of rupture is 5,690 pounds per square inch, and the modulus of elasticity 1,340,000 pounds per square inch. The average moisture was 21 per cent, and the oven-dry weight 31.2 pounds per cubic foot. The seasoning ordinarily undergone by large loblolly pine beams has little, if any, effect upon their strength.

The 8 by 8 inch partially air-dried Virginia pine was cut in Stafford county, Va., and had been drying in the yard for two years. This material has a modulus of rupture of 5,180 pounds per square inch, a modulus of elasticity of 1,180,000 pounds per square inch, at a moisture per cent of 22.4, and an oven-dry weight of 28.8 pounds per cubic foot.

The 8 by 8 inch green Virginia pine was cut about March, 1903, and was tested about one month after cutting. The timber was "sap stained," but it has been shown that this staining, or "bluing," does not impair the strength of the wood. The modulus of rupture of these beams is 3,490 pounds per square inch, the modulus of elasticity 744,000 pounds per square inch, the oven-dry weight 26.9 pounds per cubic foot, and the weight as tested 43.7 pounds per cubic foot.

The ratio of strength values of the large beams to the small beams is 0.77 for the fiber stress at elastic limit, 0.71 for the modulus of rupture, and 0.99 for the modulus of elasticity. The crushing strength of North Carolina pine, partially air dry and green, is 4,250 and 3,510 pounds per square inch, respectively. This is higher than the crushing strength of the Virginia pine, which is 2,950 pounds per square inch when partially air dry and 2,140 pounds per square inch when green. The average compressive strength at the elastic limit at right angles to grain is 469 pounds per square inch. The material was green, containing 57.1 per cent moisture.

The shearing strength parallel to grain on small blocks is 630 pounds per square inch, in material containing 83.2 per cent moisture.

MOISTURE DISTRIBUTION.

The moisture distribution in the cross section of North Carolina pine beams was determined by cutting sections 1 inch in thickness from near the center of the sticks and dividing the sections into nine parts in the directions shown in Diagrams I and II. The figures in the various parts of the sections show the percentage of moisture.

The distribution of moisture throughout the cross section was also determined on a set of disks cut from beams under three conditions of seasoning—green, air-dry and kiln-dry. Diagram II shows the distribution in the three cases, sapwood being denoted by cross-hatching.

14 inches		
32.6 per cent.	31.9 per cent.	29.3 per cent.
30.7 per cent.	30.6 per cent.	33.2 per cent.
28.6 per cent.	30.9 per cent.	29 per cent.

Average 31.7 per cent.

DIAGRAM I.—DISTRIBUTION OF MOISTURE IN CROSS-SECTION MIDWAY OF THE LENGTH OF NORTH CAROLINA LOBLOLLY PINE BEAMS.
AVERAGE OF 10 SECTIONS TAKEN FROM STICKS 8x14
INS. BY 10 FT. THE TIMBER WAS AIR-DRIED
FROM 2 TO 5 MONTHS.

In green timber that has been submerged in water for some time the moisture per cent near the surface is nearly twice that in the central part. In the air-dried sticks the drying did not penetrate to the central part at all. Section *c* was dried more quickly than the others, and the variation in the different parts is consequently greater. The sections used in both *b* and *c* were cut from sticks which were badly checked by too rapid seasoning. Along the beam variation in moisture was determined from sections cut from all beams at the quarter and center points. The moisture in the sections from the same beam varies so little that the longitudinal moisture distribution in 16-foot sticks may be taken as practically uniform, except at the ends and in cases where the percentage of sapwood varies greatly throughout the length of the beam.

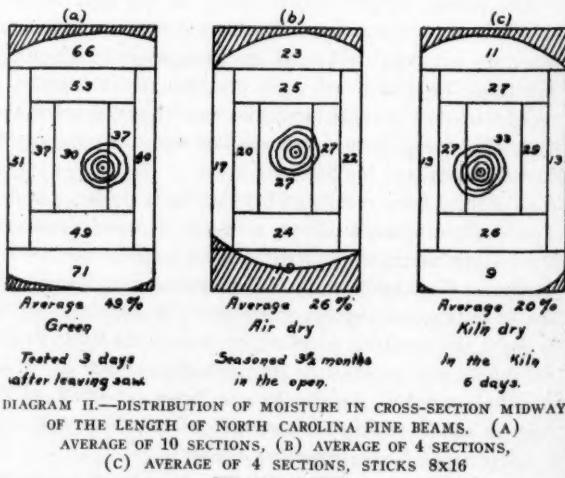


DIAGRAM II.—DISTRIBUTION OF MOISTURE IN CROSS-SECTION MIDWAY OF THE LENGTH OF NORTH CAROLINA PINE BEAMS. (A) AVERAGE OF 10 SECTIONS, (B) AVERAGE OF 4 SECTIONS, (C) AVERAGE OF 4 SECTIONS, STICKS 8x16
INS. IN SECTION.

Three sets of green North Carolina pine beams were dried in the open air in sunlight, in a kiln, and in a shed, respectively. The wood in the outer portion of the two sets of beams listed first was no doubt stronger than in the green condition. The beams failed in horizontal shear, however, before the added strength could be brought out, because of the presence of checks and shakes. A marked increase in strength was shown by the beams of select material that were carefully dried in a shed. The modulus of rupture of green material is 5,580 pounds per square inch.

The actual shearing strength of loblolly pine, as determined by tests made on small blocks, is 630 pounds per square inch. Out of 42 sticks, from 6 by 7 inches to 8 by 16 inches, tested on spans of from 10 to 16 feet, 7 failed in horizontal shear at an average stress of 339 pounds per square inch. Since the actual shearing strength of the wood fiber was 630 pounds per square inch, and the longitudinal shearing stress in the beams at failure 339 pounds per square inch, this shows that only a little over half of the horizontal section of the beams was in a condition to resist shear. The fact that engineers should design beams with reference to the unit stresses deduced from tests of green timber and to horizontal shear was pointed out in Circular 32.

Two sections were cut from all sticks tested in bending, and their average moisture content was used as the moisture content of the beam.

In a stick in which the ratio of sap to heart varies throughout the length the distribution of moisture along the beam is likely to vary also. If the stick has been wet a short time before the determinations are made, it will be found that the sections containing the most sapwood will contain the greatest amounts of moisture, because the sapwood absorbs water much more readily than the heartwood. On the other hand, if the stick has been in the water long enough for both heartwood and sapwood to become saturated, and is then dried, the sections containing the most heartwood will have the highest percentage of moisture, because sapwood dries out more readily than heartwood.

EFFECT OF KNOTS.

A series of tests was made to determine the weakening effect of knots. The timber used was North Carolina pine obtained from the E. P. Burton Lumber Company, Charleston, S. C. This was tested at the mill. The logs went to the saw directly from the millpond, and the sticks were tested within a few days after leaving the saw. The logs were sawed, in the presence of the testing engineer, so as to include knots of various positions, sizes and conditions. Ninety-three such sticks, 5 by 12 inches in cross section, were then tested in bending on a 15-foot span. Thirty-four sticks were loaded at the center, and the remainder tested under "third-point" loading.

After a few trials a method of analysis was devised in which the area of the faces of the sticks (vertical in the tests) was divided to indicate part volumes of the stick as shown above the tables. Volume 1 is the middle half

of the stick one-quarter of the height up from the bottom. A knot, wavy grain, or defect occurring in this volume throws the stick into group 1. Volume 2 is the middle half of the stick one-quarter of the height down from the top. Sticks having defects in volume 2 and not in volume 1 are put in group 2. Sticks with defects outside of volumes 1 and 2 go to group 3. The modulus of rupture for groups 1 and 2 is about 75 per cent of that in group 3. Minor test pieces free from defects were cut from the main beams in order to obtain the relative strength of these small clear pieces in the different groups.

The strength of the small test pieces cut from the sticks in group 3 was greater than that of those in groups 1 and 2. All of the sticks were green, and the results are therefore on the same moisture basis. This indicates that part of the variation in the strength of the 3 groups of large sticks is due to inherent differences in the wood fiber. The selection of such sticks as those in group 3 (sticks without defects in volumes 1 and 2) usually would involve close, firm growth, because of the fact that rapid growth and knots generally occur together.

A series of tests was also made to determine the weakening effect of knots on Douglas fir. In these tests volume 1 and volume 2 included the middle two-thirds of the stick one-quarter of the height from the edges. The beams were loaded at the center. The effect is about the same.

The following is a general rule for classifying sticks with reference to knots, wavy grain and other defects:

CLASS 1.—Sticks clear in middle half, one-quarter of height from top and bottom (not necessarily clear in remaining volume).

CLASS 2.—Sticks having defects in middle half, one-quarter of height from top or bottom.

The strength of sticks in class 2 may be taken as 75 per cent of the strength of sticks in class 1.

EFFECT OF SEASONING.

It appears that the strength of large sticks changes very little for the range of moisture usually met with in practice. Small pieces when kiln-dried increase in strength as much as 300 per cent, but large beams can not be dried out to the same extent. Moreover, the drying process often produces checks and ring shakes, the weakening effects of which more than counterbalance any gain in strength due to seasoning.

LONGLEAF PINE.

Longleaf pine has been for a long time the standard construction timber, not only on account of its strength, hardness, and durability, but also on account of the good lengths of heartwood that can be obtained free from knots.

Longleaf pine timber has been very extensively tested, not only in small sticks, but, more rarely, in large sticks as well. In the markets at present any heart pine, whether longleaf, shortleaf, or loblolly, which shows a close-ringed, hard texture, is sold under the name of longleaf pine, while the wider ringed, more rapid, and sappy growth is sold as shortleaf pine. The names "Georgia pine" and "Alabama pine" are often used to designate

timber coming from the tracts of longleaf pine in those States.

The modulus of rupture of South Carolina longleaf is 7,160 pounds per square inch, and the modulus of elasticity 1,560,000 pounds per square inch. The strength values, which are higher in the case of the Georgia timber, are 8,384 and 1,820,000 pounds per square inch, respectively. The moisture is about the same in both cases, but the rate of growth is somewhat less in the Georgia material. The average dry weight per cubic foot in the Georgia pine is 42.9 pounds as against 36.2 pounds for the South Carolina material. The strength ratio of the large to the small sticks is 0.77 for the fiber stress at elastic limit, 0.79 for the modulus of rupture and 1.01 for the modulus of elasticity.

The crushing strength parallel to grain for longleaf pine is 4,800 pounds per square inch. The material contained 26.3 per cent moisture. The compressive strength at elastic limit at right angles to grain is 572 pounds per square inch. The shearing strength parallel to grain for small specimens is 973 pounds per square inch.

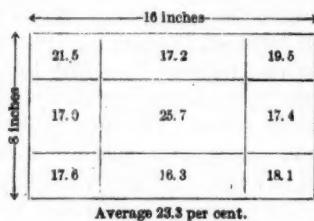


DIAGRAM III.—AVERAGE OF TWO SECTIONS OF LONGLEAF PINE TAKEN FROM STICKS 12X12 INS. AND 8X16 INS. BY 16 FT. LONG, AIR-DRIED TWO YEARS. AVERAGE PER CENT OF SAPWOOD, 2.

In Diagram III is shown the moisture distribution in the cross section of beams air-dried for two years. From this diagram it may be seen that in beams air-dried for two years the drying did not penetrate to the center. It is very noticeable in the tests that longleaf pine tends to check upon drying out and to fail by longitudinal shear. The longitudinal shearing stress in the beams that failed in that manner was 335 pounds per square inch. The shearing strength of longleaf pine, as determined from small blocks, is 973 pounds per square inch. From this it will be seen that the beams were so weakened by checks, shakes, etc., due to seasoning, that only about one-third of the longitudinal section was left in a condition to resist shear.

TAMARACK.

Tamarack reaches its best development north of the United States boundary, in Canada. It extends southward to northern Pennsylvania, northern Indiana and Illinois, and central Minnesota. In the United States tamarack occurs in pure stands in cold, deep swamps, which it often clothes with forests of densely crowded trees rarely more than 40 to 50 feet in height. The maximum height of 60 feet and the maximum diameter of 20 inches are rarely attained in the United States. The trunk is straight and tapers rather rapidly; it clears itself readily

of branches even when growing in fairly open stands. Tamarack lumber is cut principally in Wisconsin, Michigan and Minnesota.

The modulus of rupture is 4,562 pounds per square inch, and the modulus of elasticity 1,219,000 pounds per square inch. The oven-dry weight is 30.1 pounds per cubic foot, and the moisture was 50.6 per cent.

NORWAY PINE.

Norway pine reaches its best development in the United States in the northern parts of Michigan, Wisconsin and Minnesota, usually forming groves of a few hundred acres in extent on light, sandy loam or dry, rocky ridges. It ordinarily reaches a height of 75 feet and a diameter of 30 inches, though sometimes twice these dimensions are attained. The trunk is straight and clear of branches. The wood is rather close-grained, is pale red when air-dried, and has a thin ring of sapwood. Norway pine is cut and sold with white pine in the Lake states under the name of northern pine. It probably makes up about one-third of the present pine cut in this region.

The modulus of rupture is 3,975 pounds per square inch, and the modulus of elasticity 1,189,000 pounds per square inch. The oven-dry weight is 25.4 pounds per cubic foot. The moisture in the green material was 47.8 per cent.

DOUGLAS FIR.

The Douglas fir of the Pacific coast is also known commercially as yellow fir, red fir, Oregon pine, and Douglas spruce. The name Douglas fir is, however, gradually becoming established. A single species, *Pseudotsuga taxifolia*, furnishes the timber. Its range extends from Lower California to central British Columbia, and from the Pacific Ocean to the Rocky Mountains. This timber reaches its best development in western Washington and Oregon, between the summit of the Cascade Mountains and the Pacific. Almost pure forests are found here, which frequently yield from 50,000 to 100,000 board feet per acre. In these regions the tree will average 5 or 6 feet in diameter at the butt, with a height up to 300 feet. The trunk is straight and readily clears itself of branches.

It is possible, therefore, to obtain exceptionally large and long pieces for structural purposes. Sticks 24 inches square and up to 100 feet long are regularly listed and obtainable in the merchantable grades. The possibility of procuring such large pieces, combined with the exceptional strength and stiffness of the material compared with its weight, renders Douglas fir an ideal structural timber. It is almost entirely heartwood, and is fairly durable when exposed to the weather.

Small trees varying from 1 to 3 feet in diameter are unsurpassed for spars, owing to the straightness of the trunk, the small taper, and the great length obtainable. Douglas fir is almost exclusively used on the Pacific coast for piling for docks and foundations for heavy structures in soft ground. The standard dimensions for this purpose are 12 inches in diameter and from 60 to 70 feet long.

In the green logs from mature trees the sapwood forms a narrow, light-colored ring, extending usually not more than 2 inches beneath the bark. In the seasoned timber, however, it can seldom be distinguished by color. Although the grading rules allow sapwood only on the corners for the merchantable grades, lumbermen have no difficulty in meeting the requirements.

The color of the wood of Douglas fir ranges from a light yellow to a pronounced red; the grain varies from as few as 4 or 5 rings per inch, in small trees or in heart-wood, to a fine, even grain with upward of 40 rings per inch. The rings are usually strongly marked, the summer wood being very dense and dark, and the spring wood much softer. The wide-ringed wood is somewhat spongy. Owing to the marked difference in the texture of the alternate rings and to the long, regular fiber, the wood splits easily, especially when dry. For the same reason it is particularly pleasing for inside finish, paneling, etc., when slash-sawed, for the porous spring wood readily absorbs wood stains, whereas the dense summer rings are little affected, so that any desired shade may be secured.

Douglas fir is cut into every form of lumber, from rough timbers, used in the framing of heavy structures of all kinds where strength and durability are required, to the fine-grained, clear stock for flooring.

The mechanical tests were made upon market products. The sticks were graded by an experienced lumber inspector, according to the Pacific coast standard of 1900, and, as is usual in the timber tests of the Forest Service, the grading of the inspector was found to correspond closely to the average results of the mechanical tests. The size used in the tests are those generally used in railroad work for bridge, trestle, and car construction.

It is evident that Douglas fir is of varied quality and that specifications need to be drawn somewhat more carefully than in the case of longleaf pine in order to exclude the wider-ringed quick growth and knotty sticks.

From an average of all grades and sizes, it appears that the modulus of rupture of partially air-dried beams is 6,975 pounds per square inch, the modulus of elasticity 1,600,000 pounds per square inch, and the oven-dry weight per cubic foot 27.7 pounds, or 33.8 pounds per cubic foot or tested in a partially dry condition. The average rate of growth was about 15 rings per inch—that is to say, the tree added 1 inch to its radius, or 2 inches to its diameter, in fifteen years.

In green beams an average of all grades and sizes shows a modulus of rupture of 6,140 pounds per square inch, a modulus of elasticity of 1,526,000 pounds per square inch, and an oven-dry weight per cubic foot of 29.4, or 38.4 pounds per cubic foot as tested in a green condition. The rate of growth of the green beams was 10.8 rings per inch.

The ratio of the comparative bending strength of large and small sticks is 0.77 for fiber stress at elastic limit, 0.71 for modulus of rupture, and 0.99 for modulus of elasticity, in the case of partially air-dried beams, and 0.71, 0.72, and 0.87, respectively, in the case of green beams.

The crushing strength parallel to grain for Douglas fir is 4,406 pounds per square inch for partially air-dried timber. In the case of green timber the crushing strength is 3,590 pounds per square inch. The compressive strength at elastic limit, at right angles to the grain, is 651 pounds per square inch. The shearing strength parallel to grain of small blocks of partially air-dry Douglas fir is 770 pounds per square inch. Out of 216 tests on partially air-dry Douglas fir, 54 beams failed in longitudinal shear at a shearing stress of 313 pounds per square inch (average of the three sets of partially air-dry material.)

The results of the tests show that there is no marked difference in strength between fir stringers of red and of yellow color, provided the sticks have the same rate of growth and are equally free from defects.

A series of tests on small, clear, straight-grained sticks indicates that a rate of growth resulting in 21 rings per inch gives the greatest density and strength.

16 inches.		
22.7 per cent.	24.2 per cent.	22.5 per cent.
25.1 per cent.	27.2 per cent.	24.5 per cent.
22.3 per cent.	24.8 per cent.	22.4 per cent.

Average 23.9 per cent.

DIAGRAM IV.—DISTRIBUTION OF MOISTURE IN CROSS-SECTION MIDWAY OF THE LENGTH OF DOUGLAS FIR STICKS. (AVERAGE OF SIX SECTIONS TAKEN FROM STICKS 8X16 INS. BY 16 FT.)

The partially air-dry sticks were tested in from six months to one year from the time of sawing. They were kept in a shed and sprinkled to prevent drying out. The exterior parts of the beams contained less moisture than the centers, but the difference was not marked. An examination of the distribution of the moisture throughout the cross section of the 8 by 16 inch beams showed relations which are exhibited in Diagram IV. A 1-inch cross section taken midway of the stick was divided into 9 parts at third points, as shown, and the moisture in the several parts of the sections determined. The figures in the diagram are the average percentages of moisture found in each part.

WESTERN HEMLOCK.

The introduction of western hemlock to the market as a building material has met with many obstacles. Without doubt the one offering the greatest opposition to the introduction has been the strong prejudice aroused by the name of hemlock, based upon the qualities of the eastern species. So great is this prejudice even now that, although large quantities of the timber are cut and sold, it is sold under false or fictitious names, such as Alaska pine and Washington pine, spruce, or fir. Western hemlock, as such, has so far had little market standing.

Western hemlock reaches its best development in Washington, in the region lying between the summit of the Cascade Mountains and the coast, but is also found

from Alaska to central California and as far east as Idaho and Montana. The tree, where conditions best favor its development, reaches 4 feet in diameter at the butt and 200 feet in height. The trunk is straight and cylindrical, but does not readily clear itself of branches. This causes small knots in the timber and makes it impossible to obtain much clear lumber except from large trees.

The wood of the mature tree is hard, straight and even grained, and nearly white in color. The sour odor of the lumber is unmistakable. There is not the marked difference in either color or hardness between the spring and summer wood that is noticeable in Douglas fir. The wood does not split readily, and is light and tough. These qualities make it especially suitable for box manufacture. Knots are rather frequent, often dark brown to almost black in color, but usually tight and sound. The regular and even structure of the wood and the total absence of pitch render it capable of rapid kiln drying at high temperature without injury.

For flooring, molding, paneling, and all inside finish western hemlock makes a superior lumber, not easily scratched, susceptible of a high polish, and of excellent wearing qualities.

In point of strength, as shown by the tests, western hemlock is suitable for all except the heaviest structures.

The tests of partially air-dried western hemlock recorded in the tables were made upon timbers cut in Washington.

It is difficult to apply to western hemlock the grading rules adopted for Douglas fir, as these rules would throw most of the hemlock sticks into the "seconds" grade. New rules should be made for western hemlock, in order to bring the sticks of better quality into the "merchantable" grade.

The average of the results of bending tests on all grades of partially air-dried beams gives a modulus of rupture of 5,992 pounds per square inch, a modulus of elasticity of 1,351,000 pounds per square inch, and an oven-dry weight per cubic foot of 26 pounds. The rate of growth of these sticks was 12.7 rings per inch.

For all grades of green beams the modulus of rupture is 5,783 pounds per square inch, the modulus of elasticity 1,475,000 pounds per square inch, and the oven-dry weight 28.5 pounds per cubic foot. The moisture in the green beams was 36.2 per cent, against 27.8 per cent for the partially air-dried beams.

The ratio of the bending strength of the large green sticks to the small sticks cut from them is 0.70 for fiber stress at elastic limit, 0.70 for modulus of rupture, and .097 for modulus of elasticity.

The crushing strength of partially air-dry western hemlock is 3,705 pounds per square inch. The compressive strength at elastic limit at right angles to grain is 477 pounds per square inch. The shearing strength, parallel to grain, for small sticks is 746 pounds per square inch.

Out of 64 tests on western hemlock, 12 failed in longitudinal shear. The shearing stress in the beams failing in longitudinal shear was 273 pounds per square inch.

Prices on Track Materials, F. O. B. Chicago

TRACK SUPPLIES.

Steel Rail, 60 lbs. and over.....	\$28.00 per gross ton
Steel Rail, 25 to 45 lbs.....	32.00 per gross ton
Steel Rail, 20 lbs.	33.00 per gross ton
Steel Rail, 16 lbs.	34.00 per gross ton
Steel Rail, 12 lbs.	35.00 per gross ton
Ties, 6x8x8 oak, 1st grade .....	.77c each
Ties, 6x8x8 oak, 2d grade .....	.67c each
Switch Ties	\$30.00 to \$35.00 M. ft.

Angle bars, accompanying rail orders, 1907 delivery, 1.65c.; car lots, 1.75c. to 1.85c.; spikes, 2.00 to 2.10c., according to delivery; track bolts, 2.50c. to 2.60c., base, square nuts, and 2.65c. to 2.75c., base, hexagon nuts. The store prices on track supplies range from 0.15c. to 0.20c. above mill prices. Switch set per turn out, 60-lb. rail, \$85 to \$90.

OLD MATERIAL.

	Per Gr. Per Ton
Old Steel Rails, rerolled	\$14.25 to \$14.75
Old Steel Rails, less than 3 ft.....	14.50 to 15.00
Old Iron Rails	16.00 to 16.50

SHEET STEEL.

It is quoted for future delivery:

Tank plate $\frac{1}{4}$ -in. and heavier, wider than $6\frac{1}{4}$ and up to 100 in. wide, inclusive, car lots, Chicago, 1.88c. to 2.08c.; 3-16 in., 1.98c. to 2.18c.; Nos. 7 and 8 gauge, 2.03c. to 2.23c.; No. 9, 2.13c. to 2.33c. Flange quality, in widths up to 100 in., 1.98c. to 2.08c., base for $\frac{1}{4}$ -in. and heavier, with the same advance for lighter weights; Sketch Plates, Tank quality, 1.98c. to 2.18c.; Flange quality, 2.08c. Store prices on Plates are as follows: Tank Plate, $\frac{1}{4}$ -in. and heavier, up to 72 in. wide, 2.20c. to 2.30c.; from 72 to 96 in. wide, 2.30c. to 2.40c.; 3-16 in. up to 60 in. wide, 2.30c. to 2.40c.; 72 in. wide, 2.50c. to 2.65c.; No. 8 up to 60 in. wide, 2.35c. to 2.45c.; Flange and Head quality, 0.25c. extra.

STRUCTURAL STEEL SHAPES.

Store quotations are unchanged at 2.05c. to 2.10c., and mill prices are as follows: Beams and Channels, 3 to 15 in., inclusive, 1.88c.; Angles, 3 to 6 in., $\frac{1}{4}$ -in. and heavier, 1.88c.; larger than 6 in. on one or both legs, 1.98c.; Beams, larger than 15 in., 1.98c.; Zees, 3 in. and over, 1.88c.; Tees, 3 in. and over, 1.93c., in addition to the usual extras for cutting to extra lengths, punching, coping, bending and other shop work.

CAST IRON PIPE.

Quotations per net ton on Water Pipe, 4 in., \$35; 6 to 12 in., \$34; over 16 in., \$33; with \$1 per ton extra for gas pipe.

CEMENT.

Good grade Portland Cement, car lots...\$2.00 per bbl.*

*(Four sacks per bbl. credited 10c. each when returned in good condition.)

SAND.

Bank sand, car lot	\$0.65 per yd.
Torpedo sand, car lot	1.15 per yd.

CRUSHED STONE GRAVEL.

Crushed limestone, car lot	\$1.05 per yd.
Crushed gravel, car lot	1.00 per yd.

Personals

Mr. L. R. Clausen, signal engineer of the Chicago, Milwaukee & St. Paul, has been appointed superintendent of the Prairie du Chien and Mineral Point divisions, with office at Milwaukee, Wis., succeeding Mr. E. D. Wright, resigned.

Mr. J. F. Coleman has resigned as chief engineer of the New Orleans Great Northern to take effect January 1.

Mr. William J. Wilgus, who recently resigned as vice-president of the New York Central Lines, has been retained as consulting engineer by the Detroit River Tunnel Company, which is engaged in building a tunnel under the Detroit river between Detroit, Mich., and Windsor, Ont.

Mr. William Parker, division engineer of the Boston & Albany at Boston, Mass., has been appointed principal assistant engineer. Mr. L. G. Morphy, assistant to the principal assistant engineer of the New York Central & Hudson River, has been appointed assistant engineer of maintenance of way and construction of the Boston & Albany, with office at Boston. Mr. E. A. Haskell, heretofore roadmaster of the latter road at Pittsfield, Mass., has been appointed division engineer of the Boston division at Boston. Mr. W. F. Barclay has been appointed division engineer of the Albany division at Pittsfield.

Mr. A. L. Hertzberg, engineer of maintenance of way of the Canadian Pacific, has been appointed divisional engineer of the Ontario division at Toronto, Ont. The office of engineer of maintenance of way has been abolished and the duties of that position will be assumed by the assistant chief engineer, Mr. F. P. Gutelius, whose headquarters are at Montreal, Que. Mr. J. M. R. Fairbairn has been appointed divisional engineer of the eastern division at Montreal.

Mr. John O'Neill has resigned as expert of the track elevation department of the city of Chicago.

Mr. B. W. Hicks has been appointed chief engineer of the Wisconsin & Michigan, with headquarters at Peshtigo, Wis.

Mr. William C. Shaw, Jr., has been appointed chief engineer of the Georgia Southern & Florida, with office at Macon, Ga., succeeding Mr. G. B. Herrington, resigned.

Mr. J. M. Floesch, whose resignation as chief engineer of the Buffalo, Rochester & Pittsburg, effective on November 1, has been announced, will engage with a railroad contractor who will build 50 miles of the Grand Trunk Pacific in New Brunswick from Moncton westward.

Mr. W. K. Etter, superintendent of the Rio Grande division of the Atchison, Topeka & Santa Fe, has been appointed superintendent of the Oklahoma division, with

headquarters at Arkansas City, Kan., succeeding Mr. H. A. Tice, transferred. Mr. H. A. Tice has been appointed superintendent of the western division, with headquarters at Dodge City, Kan., to succeed Mr. G. E. Ayer, who is appointed superintendent of the middle division, with headquarters at Newton, Kan., in place of Mr. F. J. Easley, resigned to accept a position with another company. Mr. F. L. Meyers, trainmaster at Wellington, Kan., has been appointed to succeed Mr. Etter as superintendent of the Rio Grande division, with headquarters at San Marcial, N. M. Mr. E. Payson Ripley, trainmaster of the Rio Grande division, succeeds Mr. Meyers as trainmaster at Wellington, Kan. Mr. Daniel E. Orr has been appointed trainmaster of the Rio Grande division at San Marcial, N. M.

Mr. J. C. Larimer, heretofore division superintendent of the International & Great Northern, has been appointed superintendent of the St. Louis Southwestern, with headquarters at Mt. Pleasant, Tex., to succeed Mr. W. N. Neff, who has been transferred to the president's office.

Mr. E. E. Johnson, assistant division superintendent of the International & Great Northern, has been appointed superintendent of the Ft. Worth division, with office at Mart, Tex., succeeding Mr. C. J. Larimer, resigned. Mr. J. B. Whittington succeeds Mr. Johnson as assistant superintendent of the Ft. Worth division at Mart.

Mr. E. F. Van Hoesen has been appointed chief engineer of the Tonopah & Goldfield, with office at Tonopah, Nev., succeeding Mr. W. B. Chapin, resigned.

Mr. S. A. Mackey has been appointed supervisor of the Cleveland, Cincinnati, Chicago & St. Louis at Bellefontaine, O., succeeding Mr. E. Allebaugh, resigned.

Mr. J. F. Leonard has been appointed general inspector of signals of the Chesapeake & Ohio, with headquarters at Richmond, Va.

The jurisdiction of Mr. George W. Boschke, chief engineer of the Oregon Railroad & Navigation Company, has been extended over the Corvallis & Eastern.

Mr. H. H. Russell has been appointed assistant engineer of the Allegheny division of the Pennsylvania Railroad at Pittsburg, Pa., in place of Mr. J. R. McGraw, furloughed; effective on November 1.

Mr. F. B. Freeman, designing engineer of the New York Central & Hudson River, with headquarters at New York, has been appointed engineer of construction in charge of contract work in the exterior zone.

Mr. Alexander Brown, signal supervisor of the Chicago, Milwaukee & St. Paul, has been appointed signal engineer, with office at Milwaukee, Wis., to succeed Mr. L. R. Clausen, promoted.

The Weed Burner

An effective method of clearing a right of way of weeds is by means of the weed burner. The necessity of getting rid of this growth has always been appreciated and many methods were tried but had to be abandoned for hand labor until the weed burner was constructed. Among the difficulties which a heavy growth of weeds present, are slippery

rails and danger of fire in the fall when the weeds are dried.

The machine should be used to entirely consume the weeds and it is found to be much more economical to do this with two burnings instead of one. Weeds consist of from 70 to 90 per cent water and, if it were desired, to consume them at one burning, it would be necessary that the heat be applied for a sufficient length of time to evaporate the water in the weeds before igniting the dried-up stalks. This would necessarily make the travel of the machine very slow and the gasoline consumption very high. If, however, these weeds be subjected momentarily to a blast of intense heat, the plant life is killed and, on being exposed to the atmosphere for a day or two, dry out, the water being evaporated. On this account, it will be found to be very much more economical to burn twice to entirely consume the weeds, as in this way nature evaporates the large amount of water and the cost of the work done by the machine is reduced.

Gasoline is used for fuel for the reason that the machine can be built much more simply, a more intense flame can be developed and a large number of small burners can be used, which distribute the heat evenly under the burner frame. The burner frames are large iron castings which serve as deflectors to confine the heat and turn it down into the weeds and also serve to help the pipes vaporize the gasoline before it leaves the burners. A great deal is claimed for the burner arrangement as it develops a very hot flame and also does away with all the trouble of stopped-up burners which often occur where the burners are supplied by individual generators. The gasoline vapor is also delivered to the burner tip at a far higher temperature than is possible under any other arrangements.

The weed burner was designed especially for burning weeds and is the result of a careful study of the conditions arising in the actual destruction of growing weeds by heat. It is built entirely of steel and iron and avoids all danger of fire. It is built strong enough to withstand a great deal of rough usage without material injury.

The weed burner is made self-propelling and does not, therefore, require locomotive service. The gasoline engine, which propels the car and operates an air compressor, is securely fastened to the steel bed plate. The steel propelling mechanism is designed for two speeds and reverse, the engine speed being 350 r. p. m. The slow speed of 3 to 4 miles per hour is used, when machine is in operation, and the high speed of 12 to 15 miles per hour is used to and from work. Any speed from 2 to 20 miles may however be attained.

Of the three burner frames, the one in the center is rigid, but the side frames are raised and lowered by compressed air independently of each other. All operating levers are located within easy reach of the operator.

This machine is manufactured by the Commonwealth Steel Company, St. Louis, of which Mr. Frank S. Barks is manager, weed burner department.



THE WEED BURNER, SHOWING ADJUSTABLE BURNER FRAMES.



THE WEED BURNER, SHOWING GASOLINE TANKS.

The cost per mile varies between \$5 and \$6 for two burnings. On a basis of burning 25 miles per day the cost is distributed as follows:

Twenty gallons, 66° gasoline, at 11 cents.....	\$2.20
Engine operator, per day	\$ 3.50
Helper, per day	2.50
Conductor, per day	4.00
Oil, waste and repairs, per day	2.50

Total, per day	\$12.50
Average, per mile .....	.50

Total cost, per mile

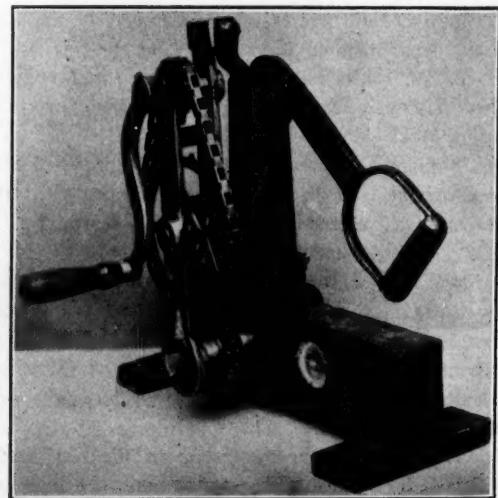
The above statement refers to one burning, the two burnings costing \$5.40 per mile.

Track Wrench and Clamp

An improved track wrench and clamp has been placed on the market by Coulter & Paxton, Longmont, Colo. The accompanying illustration shows the wrench as it is designed for both construction and repair work. It is simple in construction, has strength and combines with these qualities ease of operation.

This wrench will tighten or loosen bolts or joints in much less time than is required with the ordinary open jaw wrench, it is a necessity from the standpoint of economy. It loosens very easily nuts or old bolts, that have been in service for years, without injury to either nut or bolt. The wrench is compact in form and weighs less than 20 pounds, being easy to carry.

This wrench is adjustable to rail of any height and may be attached to or removed from the rail very quickly. It is claimed that it will pay for itself in a few days by the saving in nuts, bolts and time gained.



TRACK WRENCH AND CLAMP.

Gibraltar Mail Crane

The construction of the Gibraltar mail crane is shown in the accompanying drawing. Several changes have been made recently in the construction, which do not reduce the efficiency but enable the manufacturer to sell the device at a reduced cost.

The crane is provided with steps so that it is not necessary to use a ladder or pole to hang the mail bag in position on the upper arm, to raise the lower arm to the proper position and to attach lower arm to the bag. After hanging the bag the carrier steps to the ground and swings the arms into position along side of the track. The lever, when raised, engages in the slot in the casting and holds the crane immovable until the bag is removed.

When the bag is taken off, the lower arm falls, forcing the head of the lever back against the mast and releasing it from its engagement of the casting, mentioned above. The mast then sinks by gravity into the base and turns the upper arm to a position parallel with the rails, being guided by the handle which works in the spiral slot in the casting. The crane is in extensive use and it is claimed that the crane is giving entire satisfaction.

This crane is handled by the Gibraltar Manufacturing Company,
1410 Old Colony building, Chicago.

Benjamin Patent Steel Tie

The construction of the tie, shown in the accompanying illustration, is intended to prevent either longitudinal or lateral movement when in service. The longitudinal movement is prevented by the V-shaped arrangement of the tie, the position of the V-shaped figures alternating so that the pressure of the ballast against the diagonal portions of the channel, constituting the adjacent V. will be in opposite directions and will securely lock the ties.

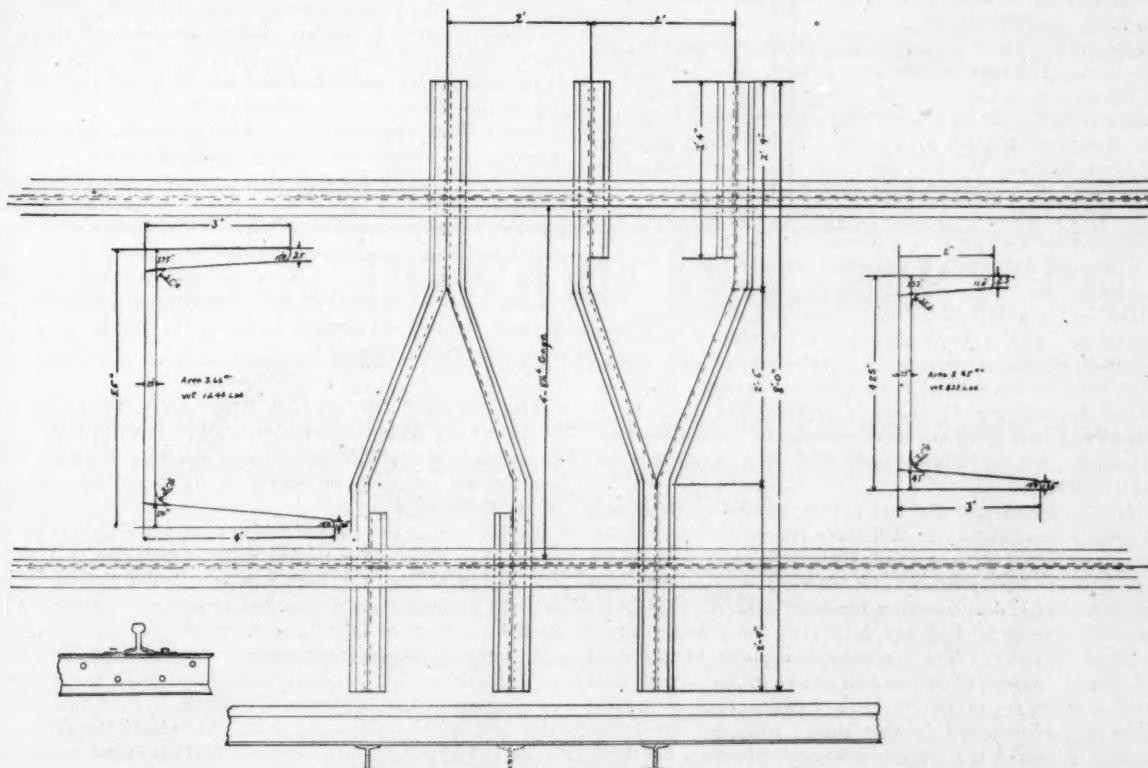
Among the advantages, secured by this tie, are the following: Creeping or lateral movement is impossible as no

The diagram illustrates the GIBRALTAR MAIL CRANE, showing its side profile. Key dimensions are indicated: the total height is 5'-5 1/2", the distance from the base to the center of the upper arm is 3'-8 1/8", and the distance from the base to the lantern hook is 3'-4 1/2". The crane consists of an upper arm (A), a lower arm (B), a mast (C), a stand (D), a base (E), and a lantern hook (L). The mast is supported by a stand (D) and a base (E). The upper arm (A) is attached to the mast (C) and the stand (D). The lantern hook (L) is attached to the lower arm (B). The parts list provides the material for each component:

Part	Material
A - Upper Arm	1 1/2" Steel Pipe
B - Lower "	" "
C - Mast	2" "
D - Stand	2 1/2" "
E - Base	Grey Iron
F - Top with spiral slot	Mol. "
G - Steps	Steel
H - Trigger 1 1/2" x 15"	"
I - Buffer Blocks	Oak
J - R	Steel
K - Finger	"
L - Holder	Mol. Iron
M - Spring	Steel
N - O - Lantern Hook	"

GIBRALTAR MAIL CRANE

two bearings of the rails will come opposite each other. The ties, which support one rail, alternate with those supporting the other rail and the track is less rigid, no two rail bearings being opposite each other. Owing to the manner of the tie construction, the rattling noise under fast trains



THE BENJAMIN PATENT STEEL TIE.

is done away with. The ties are put in as a tie and one-half with three bearings and the bearing surface under the rail has great strength with this style of tie. The bearing surface in the center of the track, being of one-half width, overcomes any tendency of the tie to become center-bound.

The rail-fastening plates or clamps are made with a shoulder adapted to bear against the edge of the flange of the track rail, and have a portion adapted to rest on the base and extend to the web of the rail so that the track would be held to the proper gauge in case the nut should become loose. The clamp is not more than $\frac{3}{8}$ -inch in thickness, and thus the danger, in case of derailment, of the flanges being sheared off is overcome as the tread of the wheel would clear clamp and nut.

The accompanying illustration shows the Benjamin steel tie, designed for steam and electric roads. The National Brake Company, of Buffalo, N. Y., which controls the patents, would be pleased to have the tie carefully criticised.

Trade Notes

Nashville Bridge Company, Nashville, Tenn., has completed its new plant and will equip it with about \$20,000 worth of machinery. During the past year the business of this company has increased 50 per cent, it is said, and it now operates in every section of the south.

Fred G. Whipple has been appointed manager of the sales department of the Wiederholdt Construction Company, with headquarters in the American Trust building, Chicago. The company makes a specialty of reinforced tile-concrete chimneys and other structures in which tile-concrete may be used to advantage.

Atlas Export & Trading Company, New York, has been incorporated with a capital stock of \$5,000 to manufacture machinery and appliances for building railroads. Incorporators: Robert T. Wood, Cold Spring, N. Y.; William L. Seyers, 218 West One Hundred and Twenty-first street, New York; Charles Stevenson, 114 West Forty-fourth street, New York.

Lawrence Cement Company, New York, manufacturer of the "Dragon" brand of Portland cement, reports that this is being used in a number of important railroad improvements in this country, among which are the new shops for the Baltimore & Ohio at Cleveland and Chicago Junction, O., and Grafton, W. Va.; track elevation and terminal at Wheeling, W. Va., and tunnel work at Dorsey's run.

S. T. DeLaMater, engineer, formerly with the Standard Construction Company of Chicago, has been engaged by the General Fireproofing Company and for the present is located at the home office in Youngstown, O. Mr. DeLaMater is a graduate of Cornell University, and through his connection with a large number of contracting firms has acquired a wide experience in reinforced concrete design and construction. Among his connections have been Osborne Engineering Company, Cleveland, O.; Paul F. P. Mueller, Falenau Construction Company, Standard Construction Company, Chicago; and L. P. & J. A. Smith Company, Cleveland, O.

It is expected that the last quarter of the Union Switch & Signal Company's year will show results almost as favorable as reported in the first three quarters. Net earnings for the year are estimated at \$1,100,000 on a total capital stock of \$2,500,000 and outstanding bonds of \$243,000. The company is free from debt and in a good position to meet a business reaction. The company has about \$1,250,000 of "accounts receivable" and enough money in the bank to meet the company's pay roll for two months, even if another cent is not collected in that time. Although the Union Switch & Signal is a Westinghouse company, it has absolutely no commitments or entanglements of any sort with any other companies. Out of a total of about 500 individual

stockholders of the Union Switch & Signal Company, there are 227 women and estates on the list.

Walter C. Kerr, president of Westinghouse, Church, Kerr & Co., one of the largest construction engineering companies in this country, passed through Pittsburg recently on his way East from Chicago. Speaking of the work his company is doing at present, he stated that they have on hand about forty contracts, representing some very important construction work. In this work are engaged upward of 100 engineers and about 7,000 operatives. One of the largest contracts that the company is engaged in is the work of the Pennsylvania Railroad Terminal in New York city. Other contracts are for the Erie, the New York, New Haven & Hartford and the Wabash railroads. The amount of money involved in the completion of this work approximates from \$25,000,000 to \$30,000,000. Mr. Kerr says his company has never been busier than at present and that the outlook for the future is exceedingly bright. Westinghouse, Church, Kerr & Co. is one of the affiliated companies of the Westinghouse interests, its headquarters being located in New York city.

Technical Publications

TABLES OF QUANTITIES FOR PRELIMINARY ESTIMATES, by E. F. Hanch and P. D. Rice. Published by John Wiley & Sons, New York. Cloth binding, 92 pages, 4x7 inches. Price, \$1.25 net.

This book, which is presented in a compact and convenient form, is for the use of the locating engineer. All calculations were made so that the tables are correct to the nearest cubic yard. Formulae and methods of calculation are given in order that tables for special cases may be prepared, tables of second differences for prisms and wedges and of second and third differences for quarter cones being appended.

STEREOTOMY, by Arthur Willard French and Howard Chapin Ives. Published by John Wiley & Sons, New York. Cloth binding, 119 pages, 5½x9 inches, with 22 extra plates and 47 illustrations. Price, \$2.50.

This volume provides a text-book on stereotomy which furnishes, in addition to exercises in projections, practical examples of modern masonry structures, directions for preparation of drawings and practical details of building stone masonry. The book will be of value to the student of stereotomy and will materially assist the instructor.

The chapter headings are as follows: Definitions and classifications; stone-cutting; plane-sided structures; structures, containing developable surfaces; the oblique or skew arch, and other problems.

THE DESIGN OF WALLS, BINS AND GRAIN ELEVATORS, by Milo S. Ketchum, C. E. Published by The Engineering News Publishing Company, New York. Cloth binding, 490 pages, 6½x9 inches, 50 tables and 240 illustrations. Price, \$4.00 net.

In this volume the various subjects are taken up systematically. The design of retaining walls is taken up first, then the design of bins for coal, ore, etc., and following upon this the design of grain bins and elevators. Algebraic and graphic methods of calculation are used.

The theory of reinforced concrete design is given in order to develop the necessary formulae. This book was written on account of the need of a systematic treatise on bin design and in this volume the author has placed the design of walls and bins on a scientific basis. There is no doubt that the book is of practical value to any engineer engaged in this class of construction work.

